CLAIMS

I claim:

1. An optical communication system for communicating one or more information signals, the optical communication system comprising an optical transmitter, the optical transmitter comprising:

spread-spectrum encoders corresponding in number to the information signals, the spread-spectrum encoders operable to multiply the information signals by respective pseudo-noise (PN) code sequences to generate respective spread-spectrum information signals;

a light source; and

modulator means for modulating light generated by the light source in response to the spread-spectrum information signals to generate a spread-spectrum optical signal for transmission, the spread-spectrum optical signal having an amplitude modulation representative of the sum of the spread-spectrum information signals.

2. The optical communication system of claim 1, wherein the modulator means comprises:

an analog summer connected to receive the spread-spectrum information signals from the spread-spectrum encoders and operable to sum the spread-spectrum information signals to provide a modulation signal; and

a modulator connected to receive the light and the modulation signal, and operable to modulate the light in response to the modulation signal to generate the spread-spectrum optical signal.

3. The optical communication system of claim 1, wherein the modulator means comprises:

modulators each connected to receive the light and a respective one of the spread-spectrum information signals and operable to modulate the light in response to the one of the spread-spectrum information signals to provide a spread-spectrum optical signal component; and

an optical combiner arranged to receive the spread-spectrum optical signal components from the modulators and operable to spatially overlap the spread-spectrum optical signal components to generate the spread-spectrum optical signal.

4. The optical communication system of claim 3, wherein the light source comprises lasers corresponding in number to the information signals.

5. The optical communication system of claim 1, wherein:

the light source comprises lasers corresponding in number to the information signals, the lasers each comprising a modulation input; and

the modulator means comprises:

electrical conductors arranged to connect the spread-spectrum information signals from the spread-spectrum encoders to the modulation inputs of respective ones of the lasers and operable to cause the spread-spectrum information signals to modulate the light generated by the lasers to provide respective spread-spectrum optical signal components, and

an optical combiner arranged to receive the spread-spectrum optical signal components and operable to spatially overlap them to generate the spread-spectrum optical signal.

6. The optical communication system of claim 1, wherein:

the optical communication system additionally comprises additional ones of the optical transmitters;

the light sources of the optical transmitters generate light at mutually different wavelengths; and

the optical communication system additionally comprises a wavelength division multiplexer connected to receive the spread-spectrum optical signals from the optical transmitters and operable to multiplex the spread-spectrum optical signals for transmission.

7. The optical communication system of claim 6, wherein the PN code sequences used in each of the transmitters are all orthogonal or quasi-orthogonal to each other.

8. The optical communication system of claim 7, wherein the PN code sequences are all orthogonal or quasi-orthogonal to each other at least in pairs of the optical transmitters of adjacent optical channels.

9. The optical communication system of claim 1, wherein the PN code sequences are all orthogonal or quasi-orthogonal to each other.

10. The optical communication system of claim 1, wherein the spread-spectrum encoder comprises:

a code sequence generator configured to generate a PN code sequence; and

a multiplier connected to receive one of the information signals and the respective PN code sequence, the multiplier operable to multiply the one of the information signals by the respective PN code sequence to produce the respective spread-spectrum information signal.

11. An optical communication system for communicating one or more information signals, the optical communication system comprising an optical receiver, the optical receiver comprising:

an optical detector arranged to receive a spread-spectrum optical signal representing at least one spread-spectrum information signal, each spread-spectrum information signal having a spectrum spread by a respective pseudo-noise (PN) code sequence, the optical detector operable to generate a spread-spectrum electrical signal in response to the spread-spectrum optical signal; and

at least one spread-spectrum decoder connected to receive the spread-spectrum electrical signal from the optical detector, each spread-spectrum decoder operable to despread the spectrum of one of the spread-spectrum information signals represented by the spread-spectrum electrical signal to recover a corresponding information signal.

12. The optical communication system of claim 11, wherein the spread-spectrum decoder comprises:

a code acquisition circuit connected to receive the spread-spectrum electrical signal and a PN code sequence corresponding to the PN code sequence used to encode one of the spread-spectrum information signals, the code acquisition circuitry operable to align the PN code sequence with the one of the spread-spectrum information signals in the spread-spectrum electrical signal;

a multiplier connected to receive the spread-spectrum electrical signal from the optical receiver and the aligned PN code sequence from the code acquisition circuitry, the multiplier operable to multiply the spread-spectrum electrical signal by the aligned PN code sequence to generate a despread information signal; and

integrating and thresholding circuits connected to receive the despread information signal from the multiplier and operable to recover the information signal from the despread information signal.

13. The optical communication system of claim 12, wherein the code acquisition circuitry comprises a cross-correlator.

14. The optical communication system of claim 11, further comprising:

a wave-division demultiplexer arranged to receive a WDM optical signal, the WDM optical signal comprising spread-spectrum optical signals having mutually different carrier wavelengths, the wave-division demultiplexer operable to spatially separate the spread-spectrum optical signals constituting the WDM optical signal from one another; and

additional ones of the optical receivers, the optical receivers being arranged each to receive a different one of the spread-spectrum optical signals from the wave-division demultiplexer.

15. The optical communications system of claim 14, wherein the PN code sequences used to spread the spectra of the spread-spectrum information signals are all orthogonal or quasi-orthogonal to each other.

16. The optical communications system of claim 14, wherein the PN code sequences used to spread the spectra of the spread-spectrum information signals represented by ones of the spread-spectrum optical signals in adjacent optical channels are all orthogonal or quasi-orthogonal to each other.

17. An optical communication method, comprising performing a spread-spectrum optical signal generating process, the spread-spectrum optical signal generating process comprising:

receiving information signals;

generating orthogonal or quasi orthogonal pseudo-noise (PN) code sequences;

multiplying each of the information signals by a respective one of the PN code sequences to generate a respective spread-spectrum information signal;

generating light; and

modulating the light in response to the spread-spectrum information signals to generate for transmission a spread-spectrum optical signal having an amplitude modulation representative of the sum of the spread-spectrum information signals.

18. The optical communication method of claim 17, wherein the modulating comprises:

summing the spread-spectrum information signals to provide a modulation signal; and

modulating the light in response to the modulation signal to generate the spread-spectrum optical signal.

19. The optical communication method of claim 17, wherein the modulating comprises:

individually modulating the light in response to each one of the spread-spectrum information signals to provide a spread-spectrum optical signal component; and

spatially overlapping the spread-spectrum optical signal components to generate the spread-spectrum optical signal.

20. The optical communication method of claim 17, wherein:

the optical communication method additionally comprises performing additional ones of the spread-spectrum optical signal generating process to generate respective spread-spectrum optical signals having different carrier wavelengths; and

wavelength division multiplexing the spread-spectrum optical signals having the different carrier wavelengths to generate a wavelength-division multiplexed optical signal for transmission.

21. An optical communication method, comprising performing a spread-spectrum optical signal receiving process, the spread-spectrum optical signal receiving process comprising:

receiving a spread-spectrum optical signal representing spread-spectrum information signals, each spread-spectrum information signal having a spectrum spread by a respective pseudo-noise (PN) code sequence;

converting the spread-spectrum optical signal to a spread-spectrum electrical signal; and

applying spread-spectrum decoding to the spread-spectrum electrical signal, comprising using a corresponding PN code sequence to despread the spectrum of each of the spread-spectrum information signals represented by the spread-spectrum electrical signal to recover a respective one of the information signals.

22. The optical communication method of claim 21, additionally comprising:

receiving a WDM optical signal comprising spread-spectrum optical signals having respective different carrier wavelengths;

demultiplexing the WDM optical signal to recover the spread-spectrum optical signals; and

performing the spread-spectrum optical signal receiving process on each of the spread-spectrum optical signals.